

adopted, and information is here given for that purpose. The Bessemerising of copper mattes is briefly described. Silver-copper smelting and refining is limited in its application to ores comparatively free from sulphur, arsenic, and lead, and therefore but little used. The plant employed is specified and illustrated by diagrams and tables. The book concludes with a short account of the various wet methods used for argentiferous slimes. The author's attempt to cover the ground embraced by such a wide subject within a moderate compass will, with the aid of tables and summaries, prove most valuable both to practical men and to students.

OUR BOOK SHELF.

The History of Language. By Henry Sweet, M.A. Pp. xi + 148. (London: J. M. Dent and Co., 1900.)

THERE are few living scholars who are so well qualified as Dr. Sweet to write a thoroughly comprehensive introduction to the science of language. He is, as is well known, one of the foremost European authorities on phonetics; but at the same time he is a profound and original thinker on those psychological aspects of linguistic science in which few phoneticians take any interest. And while possessing a competent knowledge of Indogermanic comparative philology in its latest developments, he is preserved from the narrowness of view of the mere Indogermanist by having made a practical study of Arabic, Finnish and Chinese. Notwithstanding its small size, this "primer" is a very remarkable book. In completeness of outline, it is superior to any elementary manual of the subject known to us; and it is no mere arid skeleton, but contains a good deal of novel and interesting illustration of the principles expounded. Perhaps it is not quite so easy to master as a "primer" is usually expected to be. Although strictly elementary, in the sense that it assumes no previous philological knowledge on the reader's part, it does undoubtedly demand considerable power of close attention and some training in habits of scientific thought. It will therefore probably be less acceptable to absolute beginners than to those who have already some general knowledge of the subject and desire to render their conceptions of it more systematic and precise. Even by advanced philological scholars it may be studied with interest and profit.

The contents of the book may be said to consist of three portions: an exposition of the general principles affecting the development of language, an outline of the history of the Aryan family of languages, and a statement of the author's views as to the exterior affinities of Aryan and the locality in which it was developed. Perhaps the third part is somewhat out of place in an elementary book, but it is at any rate interesting. Dr. Sweet's hypothesis is that primitive Aryan arose in Scandinavia out of a mixture of the language of Ugrian conquerors with that of the aboriginal population among whom they were absorbed. This is not now such a startling heresy as it would have been a few years ago, though it is not likely at present to find a ready welcome from Indogermanists. The apparent affinities between Aryan and Ugrian certainly seem too striking to be due to mere coincidence, but it is a long step from this admission to the acceptance of the definite theory here propounded. The writers who have hitherto advocated somewhat similar views have always discredited their case by their ignorance of philology and their lack of scientific caution. It is to be hoped that Dr. Sweet will give to the world a full exposition of the grounds on which his conclusions are based. Whether he succeeds

in the establishment of his particular thesis or not, he can hardly fail to make a valuable contribution towards the ultimate solution of the question.

Micro-organisms and Fermentation. By Alfred Jörgensen. Pp. xiii + 318. (London: Macmillan and Co., Ltd., 1900.)

THE study of the biology of fermentation has made considerable progress in recent years. The knowledge that has been gained of the nature and mode of action of the living agents in question is mainly due to the efforts of foreign observers. Through the investigations of Pasteur, and most notably of Hansen, the subject became a recognised branch of methodical and practical inquiry. To be in a position to employ the essential and to exclude the deleterious agents in a fermentative process is to substitute scientific for haphazard methods. This, briefly put, is the aim of technical mycology, and the gain to a given industry is considerable, as *e.g.* in brewing and distilling operations. Of the books dealing with micro-organisms and fermentation, Dr. Jörgensen's has long occupied a leading position, and hardly requires an introduction to the specialist. The new edition just issued has been completely revised, and the English translation has been well done by Dr. A. K. Miller and Mr. A. E. Lennholm. Dr. Jörgensen's reputation as a teacher and investigator, as well as his intimate association with Hansen, place this work above the ordinary run of text-books. The first chapters deal with the methods of microscopical and physiological examination of micro-organisms, and the methods for obtaining and utilising pure cultures of the useful races of *Saccharomyces* are described. The examination of water and air is next dealt with—a subject of importance on account of the injurious organisms that may exist in the air and water of a brewery. The chapter on bacteria is somewhat incomplete. The technical mycologist has commenced to study the bacteria more closely, and a fuller account of this branch of the subject will be found in Lafar's book. An interesting account is given of the alcohol-forming bacteria, and of certain symbiotic ferments, *e.g.* Kephir and the ginger-beer plant. The moulds of importance in technical work are fully dealt with.

Of recent work, Buchner's "Zymase" is shortly alluded to; but more mention might have been made of Calmette's investigations at Lille and Sèclin upon the symbiotic action of moulds and yeasts in the alcoholic fermentation. The account of the alcoholic ferments in Chapter v. is naturally the main and distinctive feature of this work, and it will be particularly valuable to the English reader on account of the lucid description it contains of Hansen's investigations upon yeasts. The various species of bottom and top fermentation yeasts of interest to the brewing chemist are fully dealt with. The final chapter is devoted to the application of the results of scientific research in practice. The value of the book is added to by a number of illustrations and a very full bibliography. As an introduction to the morphology and biology of the alcoholic ferments, Dr. Jörgensen's work leaves little to be desired, and constitutes a valuable complement to the text-books which deal mainly with the chemical side of the subject.

A. M.

Photography in Colours. By R. C. Bayley. Pp. 74. (London: Iliffe, Sons and Sturmeay, Ltd., 1900.)

THIS little book is practically a reprint of a series of articles by the author which have already appeared in a photographic periodical, but the subsequent revisions and convenience of reference occasioned by their collection under one cover should render them more serviceable. The general principle has been to avoid technicalities and purely executive details, aiming rather to

give a lucid explanation of the principles governing the various processes, which may be understood by readers not necessarily acquainted with photographic manipulation.

The opening chapters introduce the elementary ideas of the nature of colour and the undulatory theory of light. Following these is a chapter on the Lippmann process, this being the only direct process having a purely physical origin.

The fourth chapter deals with the principles of colour vision, showing how the colour curves of red, green and blue sensitiveness are employed in deciding the screens used in the three-colour photographic process; two processes of this type, founded by Ives and Joly respectively, being then fully explained.

The work is brought up to date by descriptions of Wood's diffraction grating process, and later improvements on the Joly process. A chapter is also devoted to three-colour photomechanical processes, and another to the method developed by Sanger Shepherd and others of producing lantern slides in three colours.

Leçons nouvelles sur les applications géométriques du calcul différentiel. Par W. de Fannenberg, Professeur à la Faculté des Sciences de l'Université de Bordeaux. Pp. 192. (Paris: A. Hermann, 1899.)

THE geometrical applications of the differential calculus, which are usually given in English treatises on the calculus, are mostly confined to plane curves. In these lessons, on the contrary, the author begins by assuming a knowledge of elementary analytical geometry of three dimensions, and proceeds at once to deal with subjects which occur in the latter part of an English text-book on solid geometry, in chapters on the general theory of curves and surfaces.

Thus we have sections on the descriptive properties of tortuous curves and curved surfaces, followed by sections on the metrical properties of tortuous curves, of ruled surfaces, and of surfaces in general.

The author's treatment of his subject is exceedingly clear and elegant, and there is considerable freshness of method. We may notice, in particular, the early employment of the six co-ordinates of a line; the use of the system of moving axes formed by the tangent, the principal normal and the binormal at a point on a curve; the systematic application of Gaussian curvilinear co-ordinates in developing the properties of the several classes of curves that may be traced on a surface.

In fact, a student will find here in small compass a pleasant introduction to some of the most powerful methods of modern analysis as applied to geometry, and if he proceeds afterwards to the "Leçons sur la théorie générale des surfaces," by Darboux, his study of that great classic will have been much facilitated.

Elementary Illustrations of the Differential and Integral Calculus. By Augustus De Morgan. New Edition. Pp. viii+142. (Chicago: The Open Court Publishing Company. London: Kegan Paul and Co., Ltd., 1899.)

It is nearly seventy years since De Morgan first published this tractate in the Library of Useful Knowledge. It was afterwards bound up with his large treatise on the differential and integral calculus, but the very inferior typography detracts much from the pleasure of perusing it there. In the present issue we have a very attractive reprint. Although there has been in recent years almost a superabundance of elementary treatises on the calculus, some of them not lacking excellent illustrations of the fundamental principles and processes of the subject, it may still be said that De Morgan's effort at popularisation remains the greatest of its kind, and far above all others in the philosophic spirit which animates it.

NO. 1600, VOL. 62]

LETTER TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

A Surface-Tension Experiment.

If an unbroken vertical jet of falling water is allowed to impinge normally on a smooth circular disc, whose diameter is rather greater than that of the jet, then a phenomenon, illustrated by the accompanying photographs, is observed. These are one-ninth natural size.

A disc about 7 mm. in diameter was supported on the upper end of a knitting-pin, which was held vertically in a clamp.

A jet of water proceeding from a tube of 6 mm. internal diameter was directed downwards, so as to strike the disc centrally.

If the initial velocity of the jet is high, then an umbrella-shaped sheet is formed, which breaks up into a shower of drops at its margin. On diminishing the rate of outflow, the broken

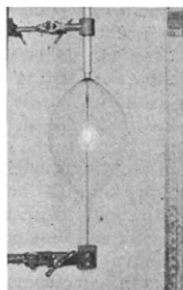


FIG. 1.
4000 c.c. per min.

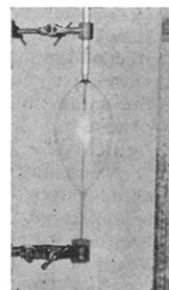


FIG. 2.
3000 c.c. per min.

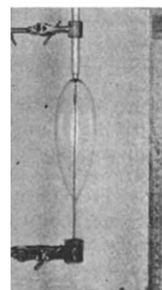


FIG. 3.
2100 c.c. per min.

edge of the sheet gathers itself together and closes inwards until it reaches the upright supporting the disc, thus forming a completely closed pear-shaped surface (Fig. 1). The surface-tension of the falling sheet thus drags in the water radially, for if it were in separate drops these would describe parabolic paths.

On further restricting the water supply there is, in general, a tendency for the surface to elongate and at the same time to contract laterally, thus becoming more spindle-shaped (Figs. 2 and 3). In this condition the figure is remarkably steady and well defined.

With a still slower stream of water (Fig. 4), the spindle reaches a certain critical length at which it first begins to

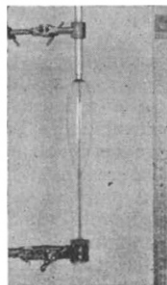


FIG. 4.
1600 c.c. per min.

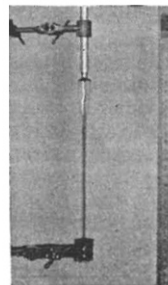


FIG. 5.
1000 c.c. per min.

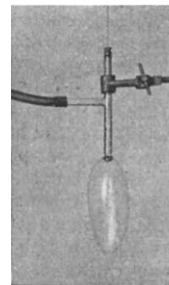


FIG. 6.

oscillate vertically and to pulsate, and then a sudden constriction occurs causing the division of the spindle into two bubbles, one of which rushes down and the other up the vertical support.

The latter bubble persists as a small conical figure immediately beneath the disc (Fig. 5).

Since there is an almost instantaneous transition from Fig. 4 to Fig. 5, it was not found possible to photograph any of the intervening conditions.